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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

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Applicant:	Dovek et al.		
Assignee:	Maxtor Corporation		
Title:	MAGNETIC STORAGE DEVICE WITH FLUX-GUIDED MAGNETORESISTIVE HEAD USING A PERPENDICULAR RECORDING MEDIA (AS AMENDED)		
Serial No.:	09/067,795	Filed:	April 28, 1998
Examiner:	Korzuch, W.	Group Art Unit:	2754
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ASSISTANT COMMISSIONER FOR PATENTS
Washington, D.C. 20231

SUPPLEMENTAL APPEAL BRIEF
(37 C.F.R. § 1.192)

This Supplemental Appeal Brief is filed in response to the Office Actions dated December 19, 2000 and February 21, 2001, and supercedes the Appeal Brief filed on October 3, 2000.

Applicant hereby requests reinstatement of the appeal.

No fee is believed to be due. However, if the Office believes a fee is due, please charge Deposit Account No. 13-0016/276.

This paper is submitted in triplicate.

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I. REAL PARTY IN INTEREST

The real party in interest in this appeal is Maxtor Corporation.

II. RELATED APPEALS AND INTERFERENCES

There are no other appeals or interferences that will directly affect or be directly affected by or have a bearing on the Board's decision in this appeal.

III. STATUS OF CLAIMS

A. Total Number of Claims in Application

Claims in the application are: 1-60

B. Status of All Claims

1. Claims canceled: NONE
2. Claims withdrawn: NONE
3. Claims pending: 1-60
4. Claims allowed: NONE
5. Claims rejected: 1-60

C. Claims on Appeal

Claims on appeal are: 1-60

IV. STATUS OF AMENDMENTS

No response has been filed after the Office Action dated December 19, 2000.

V. SUMMARY OF INVENTION

The present invention is generally directed to a magnetic recording system that includes a magnetic storage media, a yoke, a magnetoresistive (MR) read element, and a circuit. The magnetic storage media includes perpendicular magnetic polarity transitions. The yoke includes a read gap for sensing the perpendicular magnetic polarity transitions. The read element is in a flux flow path of the yoke and produces a readback pulse with a substantially Lorentzian pulse shape in response to a perpendicular magnetic polarity transition. The circuitry is adapted to receive the readback signal and detect the substantially Lorentzian pulse shape.

Lorentzian pulse shapes are discussed throughout the specification. For instance, Figure 5 shows a Lorentzian pulse shape, and Figure 7 shows a Lorentzian-like pulse shape with higher amplitude values on either side of the peak than an ideal Lorentzian pulse shape. Furthermore, Lorentzian pulse shapes are well known by those skilled in the art. See, for instance, Magneto-Resistive Heads : Fundamental and Applications by John C. Mallinson, Academic Press, Inc., 1996, pages 64, 81, 83 and 87; and Magnetic Storage Handbook by C. Denis Mee and Eric D. Daniel, McGraw-Hill, 1996, pages 2.12-2.13, as set forth in the Response dated June 18, 1999, at Exhibit A.

VI. ISSUES

The issues on appeal are (1) whether claims 1-4, 6, 7, 10, 11, 13-15, 17-19, 21, 24-27, 29-34, 37, 42-50, 53, 55, 57, 58 and 60 are anticipated under 35 U.S.C. § 102(b) by *Tanaka et al.* (U.S. Patent No. 5,486,967); (2) whether claims 1-60 are unpatentable under 35 U.S.C. § 103(a) over *Hesterman et al.* (U.S. Patent No. 5,434,733) in view of *Hamilton* (U.S. Patent No. 4,423,450); and (3) whether claim 55 is unpatentable under 35 U.S.C. § 103(a) over *Somers* (U.S. Patent No. 5,097,371) in view of *Hamilton*.

VII. GROUPING OF CLAIMS

For the first issue, the claims are grouped as follows: (i) claims 1, 3, 6, 11, 13-15, 17, 19, 21, 24-27, 29, 30, 42, 47, 57, 58 and 60, (ii) claims 4, 18 and 43, (iii) claim 7, (iv) claim 10, (v) claim 31, (vi) claim 32, (vii) claim 33, (viii) claim 34, (ix) claim 44, (x) claim 45, (xi) claim 46, (xii) claims 48 and 53, (xiii) claim 49, (xiv) claim 50, and (xv) claim 55.

For the second issue, the claims are grouped as follows: (i) claims 1-3, 5-17, 19, 21-27, 29-33, 37, 42, 47-50, 52-54 and 58-60, (ii) claims 4, 18 and 43, (iii) claims 7, 28 and 51, (iv) claims 20 and 38, (v) claim 34, (vi) claim 35, (vii) claim 36, (viii) claim 39, (ix) claim 40, (x) claim 41, (xi) claim 44, (xii) claim 45, (xiii) claim 46, (xiv) claim 55, (xv) claim 56, and (xvi) claim 57.

For the third issue, claim 55 is the sole claim.

VIII. ARGUMENTS

A. Section 102 Rejections

Claims 1-4, 6, 7, 10, 11, 13-15, 17-19, 21, 24-27, 29-34, 37, 42-50, 53, 55, 57, 58 and 60 are rejected under 35 U.S.C. § 102(b) as being anticipated by *Tanaka et al.* (U.S. Patent No. 5,486,967).

Tanaka et al. discloses a magnetic disk memory system that employs a magnetic disk with perpendicular recording. The system also employs a magnetoresistive (MR) read element that provides readback pulses in response to the perpendicular magnetic polarity transitions on the disk. These readback pulses resemble sine waves. For instance, Figs. 8-10 and 12 illustrate readback pulses provided by the read element in Fig. 5 (col. 9, lines 55-57 and 61-63). In every instance, the readback pulse generated in response to a perpendicular magnetic polarity transition resembles a sine wave. The readback pulse does not even remotely resemble a substantially Lorentzian pulse shape.

The first embodiment includes the read element in Fig. 5. In the seventh embodiment (col. 28, line 14 to col. 29, line 18), "The above embodiment is different from the embodiment 1 previously described in that the recording coil 911 is not wound around the main magnetic poles 904a and 904b, but are wound around the return magnetic pole 910 provided on the main magnetic poles." (col. 28, lines 3-7.) In the eighth embodiment (col. 28, line 19 to col. 30, line 6) a yoked MR read element is disclosed. "In this embodiment, the same effects of the embodiment 7 can be obtained." (col. 30, lines 5-6.) Therefore, *Tanaka et al.* teaches that in the eighth embodiment, a yoked MR read element provides readback pulses that resemble sine waves in response to perpendicular magnetic polarity transitions on a disk.

In stark contrast, the inventors of the present invention discovered that a yoked MR read element can provide a readback signal with a substantially Lorentzian pulse shape in response to a perpendicular magnetic polarity transition on a disk.

The captioned-application explains that a conventional non-yoked MR read element (Fig. 1) can provide a readback signal with a substantially Lorentzian pulse shape (Fig. 5) in response to a longitudinal magnetic polarity transition on a disk, and that a conventional yoked MR read element (Figs. 2 and 3) can provide a readback signal that resembles a step function (Fig. 4) in response to a longitudinal magnetic polarity transition on a disk.

> As mentioned previously, the configurations shown in Figs. 2 and 3 have advantages over conventional non-yoked head configurations. For example, recessing the MR element 82 from the surface of disk 86 eliminates the problems of thermal asperities, electrostatic discharge and element material corrosion. The head configurations shown in Figs. 2 and 3, however, suffer from a different problem. More specifically, the readback signal generated by the conventional yoked-head configurations illustrated in Figs. 2 and 3 during detection or reading of data is a non-ideal pulse signal, as shown in Fig. 4.
>
> In contrast, in most magnetic recording systems, the readback signal generated during a read operation has an ideal pulse shape known as a Lorentzian shape, as shown in Fig. 5. This shape is ideal because it resembles a pulse signal best suited for detection by state of the art detectors. Once delivered to a detector, the Lorentzian-type pulses are read and converted to digital data.
>
> When non-ideal pulse signals are read by conventional yoked MR heads, electronic signal processing techniques must be used to convert the pulse signals into Lorentzian-shaped pulses when partial response like channels are used. For example, the signal shown in Fig. 4 can be converted to a Lorentzian shape by differentiation. The problem with using electronic signal processing techniques is that the signal noise is increased. Also since additional hardware is required to implement the electronic signal processing, such hardware occupies valuable space within the disk drive unit. (Page 7, line 17 to page 8, line 19.)

The captioned-application further explains that the readback pulse for a yoked MR read element could change shape depending on whether the magnetic polarity transitions are longitudinally or perpendicularly recorded.

> In conceiving the present invention, it was recognized that a non-ideal readback pulse was generated by conventional yoked MR heads because the magnetic transition data (referenced by numeral 14 in Fig. 2 and numeral 89 in Fig. 3) being read by the MR head (referenced by numeral 10 in Fig. 2 and 80 in Fig. 3) were longitudinally written on the surface of the magnetic media. In contrast, the present invention provides a magnetic media having perpendicularly-recorded magnetic transition data thereon.
>
> A perpendicular magnetic recording media typically consists of the combination of a magnetic underlayer and a recording media that is fabricated such that the orientation of the magnetic easy axis is perpendicular to the disk surface. Therefore, when a magnetic flux is produced along the orientation of the magnetic axis, perpendicular data transitions are written into the disk media. The combination of a perpendicular magnetic recording media and a flux-guided (yoked) MR head provides the advantages of producing a readback pulse signal that has a substantially Lorentzian-type pulse shape without the problems of thermal asperities, electrostatic discharge and element material corrosion. As a further advantage, the present invention does not suffer from the performance degradation associated with having to electronically process the readback pulse signal into a Lorentzian-type pulse. (Page 14, line 6 to page 15, line 4.)

Tanaka et al. fails to teach or suggest a read element that produces a readback pulse having a substantially Lorentzian pulse shape, much less circuitry adapted to detect that the readback pulse has a substantially Lorentzian pulse shape.

Claim 1 recites "said magnetoresistive read element produces a readback pulse having a substantially Lorentzian pulse shape in response to one of said perpendicular magnetic polarity transitions" and "circuitry adapted to receive a readback pulse with a

substantially Lorentzian pulse shape from said head and to detect said substantially Lorentzian pulse shape."

Claim 17 recites "a magnetoresistive element mounted in said flux guide for producing a readback pulse having a substantially Lorentzian pulse shape in response to said magnetic flux; and circuitry adapted to receive a readback pulse having a substantially Lorentzian pulse shape from said magnetoresistive element and to detect that said readback pulse has said substantially Lorentzian pulse shape."

Claim 30 recites "a magnetoresistive read element . . . for producing readback pulses with substantially Lorentzian pulse shapes in response to and in one-to-one correspondence with said perpendicular magnetic polarity transitions . . . and circuitry adapted for receiving readback pulses with substantially Lorentzian pulse shapes from said magnetoresistive read element, wherein said circuitry includes a detector designed to detect Lorentzian pulse shapes."

In sustaining this rejection, the Examiner refers to the Office Action dated April 29, 1999. In that Action, the Examiner states "With regard to claims 1, 17, 27 and 29, Tanaka et al shows in Figure 47 a head for use in a magnetic recording system including a magnetic media (912) with perpendicular magnetic polarity transitions written thereto, the head for transferring data between the magnetic media and an exterior environment, the head including: a write element (924) for inducing the perpendicular magnetic polarity transitions into a surface of the magnetic media during a write operation; and a yoke (920a) disposed within the write element, the yoke having a read gap (921) for sensing the perpendicular magnetic polarity transitions." In the outstanding Action, the Examiner also states "Tanaka must inherently be able to detect the Lorentzian-shaped pulse produced from the head or the head would not work."

Tanaka et al. fails to teach or suggest that the read element in Figure 47 (the eighth embodiment) provides a readback pulse with a substantially Lorentzian pulse shape. In fact, *Tanaka et al.* shows a readback pulse that resembles a sine wave in Figs. 8-10 and 12 for the read element in the first embodiment, and makes no distinction

between the shape of the readback pulses in the first and eighth embodiments. Thus, *Tanaka et al.* not only suggests that the read element in the eighth embodiment provides a readback pulse that resembles a sine wave, but also teaches away from a read element in the eighth embodiment that provides a readback pulse with a substantially Lorentzian pulse shape.

Furthermore, even if one presumes *arguendo* that the read element in the eighth embodiment provides a readback pulse with a substantially Lorentzian pulse shape (although *Tanaka et al.* says nothing about this), *Tanaka et al.* fails to teach or suggest that the circuitry that receives the readback pulse can "detect said substantially Lorentzian pulse shape" (claim 1) or "detect that said readback pulse has said substantially Lorentzian pulse shape" (claim 17) or include "a detector designed to detect Lorentzian pulse shapes" (claim 30). Instead, *Tanaka et al.* suggests that the circuitry is designed to detect a readback pulse that resembles a sine wave.

The Examiner's remark that *Tanaka et al.* must inherently contain such circuitry is both unsupported and inconsistent with *Tanaka et al.* Applicant need not speculate as to why *Tanaka et al.* discloses a yoked MR read element that provides a readback pulse resembling a sine wave in response to a perpendicular magnetic transition on a disk, or whether the circuit is operative. The point is that one of ordinary skill in the art would infer that *Tanaka et al.* includes a detector designed to detect readback pulses that resemble sine waves.

Various dependent claims recite additional limitations that distinguish over *Tanaka et al.*

Claim 4 recites "said substantially Lorentzian pulse shape includes a peak near zero head position with respect to said one of said perpendicular magnetic polarity transitions," claim 18 recites "said substantially Lorentzian pulse shape includes a peak near zero head position with respect to and in response to one of said perpendicular magnetic polarity transitions," and claim 43 recites "said readback pulses have peaks near zero head positions with respect to said perpendicular magnetic polarity transitions."

Tanaka et al. discloses readback pulses that resemble sine waves in which the midpoint (between the positive and negative cycles) is near zero head position with respect to one of the perpendicular magnetic polarity transitions. In sustaining this rejection, the Examiner states "With regards to claims 2, 4 and 18, Tanaka et al further shows a magnetoresistive element (907) mounted in a flux flow path of the yoke." Accordingly, the Examiner has not addressed this feature.

Claim 7 recites "said write element includes a non-magnetic spacer for substantially preventing flux flow through said write element during a read operation." *Tanaka et al.* fails to teach or suggest this approach. In sustaining this rejection, the Examiner states "Tanaka et al further shows the write element includes a non-magnetic spacer (i.e., between 923 and 924) for substantially preventing flux flow through the write element during a read operation." Applicant respectfully submits that the gap between the read and write elements is not a spacer within the write element.

Claim 10 recites "said yoke includes first, second and third pole pieces in a common plane with said read gap, said common plane being defined by masking during fabrication." *Tanaka et al.* fails to teach or suggest this approach. In sustaining this rejection, the Examiner states "Tanaka et al further shows first (920a), second (920b) and third (924) pole pieces that are in a common plane with the read gap." Applicant respectfully submits that the third (924) pole piece is not in a common plane with the first (920a) and second (920b) pole pieces.

Claim 31 recites "said magnetoresistive read element is sufficiently recessed from said magnetic storage media to prevent thermal asperities in said magnetoresistive read element." *Tanaka et al.* fails to teach or suggest this approach. Moreover, the Examiner has not even attempted to address this feature.

Claim 32 recites "said magnetoresistive read element is sufficiently recessed from said magnetic storage media to prevent electrostatic discharge between said magnetoresistive read element and said magnetic storage media." *Tanaka et al.* fails to

teach or suggest this approach. Moreover, the Examiner has not even attempted to address this feature.

Claim 33 recites "said magnetoresistive read element is sufficiently recessed from said magnetic storage media to prevent chemicals on said magnetic storage media from corroding said magnetoresistive read element." *Tanaka et al.* fails to teach or suggest this approach. Moreover, the Examiner has not even attempted to address this feature.

Claim 34 recites "said detector includes means for detecting Lorentzian pulse shapes." *Tanaka et al.* fails to teach or suggest this approach. Moreover, the Examiner has not even attempted to address this feature, much less explain how *Tanaka et al.* discloses a detector that is the same or equivalent to that disclosed in the captioned-application.

Claim 44 recites "said readback pulses are substantially symmetric about zero head positions with respect to said perpendicular magnetic polarity transitions." *Tanaka et al.* discloses readback pulses that resemble sine waves in which the midpoint (between the positive and negative cycles) is near zero head position with respect to one of the perpendicular magnetic polarity transitions. Moreover, the Examiner has not even attempted to address this feature.

Claim 45 recites "said readback pulses have peaks near and are substantially symmetric about zero head positions with respect to said perpendicular magnetic polarity transitions." *Tanaka et al.* discloses readback pulses that resemble sine waves in which the midpoint (between the positive and negative cycles) is near zero head position with respect to one of the perpendicular magnetic polarity transitions. Moreover, the Examiner has not even attempted to address this feature.

Claim 46 recites "said readback pulses have a single voltage polarity with respect to a baseline voltage between said readback pulses." *Tanaka et al.* discloses readback pulses that resemble sine waves in which the midpoint (between the positive and negative cycles) is near zero head position with respect to one of the perpendicular magnetic

polarity transitions. Moreover, the Examiner has not even attempted to address this feature.

Claim 48 recites "said yoke includes first, second and third pole pieces, said first and third pole pieces are in said write flux guide and provide write poles that define said write gap, and said first and second pole pieces are in said read flux guide and provide read poles that define said read gap." *Tanaka et al.* fails to teach or suggest this approach. Moreover, the Examiner has not even attempted to address this feature.

Claim 49 recites "said first, second and third pole pieces are substantially aligned with one another and define a plane that is substantially parallel to a top surface of said magnetic storage media." *Tanaka et al.* fails to teach or suggest this approach. Although the Examiner states "Tanaka et al further shows first (920a), second (920b) and third (924) pole pieces that are in a common plane with the read gap," Applicant respectfully submits that the third (924) pole piece is not in a common plane with the first (920a) and second (920b) pole pieces.

Claim 50 recites "said magnetoresistive read element connects said first and second pole pieces." *Tanaka et al.* fails to teach or suggest this approach. Moreover, the Examiner has not even attempted to address this feature.

Claim 55 recites "said head includes write coils disposed between said first and third pole pieces but not between said first and second pole pieces." *Tanaka et al.* fails to teach or suggest this approach. Moreover, the Examiner has not even attempted to address this feature.

Under 35 U.S.C. §102, anticipation requires that each and every element of the claimed invention be disclosed in the prior art. *Akzo N.V. v. United States International Trade Commission*, 1 USPQ 2d 1241, 1245 (Fed. Cir. 1986), *cert. denied*, 482 U.S. 909 (1987). That is, the reference must teach every aspect of the claimed invention. See M.P.E.P. § 706.02.

Tanaka et al. fails to teach or suggest key elements of independent claims 1, 17 and 30 as well as numerous dependent claims. Therefore, Applicant respectfully requests that these rejections be overturned.

B. Section 103 Rejections – Claims 1-60

Claims 1-60 are rejected under 35 U.S.C. § 103(a) as being unpatentable over *Hesterman et al.* (U.S. Patent No. 5,434,733) in view of *Hamilton* (U.S. Patent No. 4,423,450).

Hesterman et al. discloses a read/write head that includes a yoked MR element in a longitudinal recording system. Head 10 includes read gap 15 and write gap 17. Poles 30 and 31 are define read gap 15, and poles 31 and 32 define write gap 17. Poles 30 and 31 are separated from one another at read gap 15, and poles 31 and 32 are connected at write gap 17 by magnetic shunt 16. MR element (MRE) 18 is positioned on poles 30 and 31 opposite read gap 15. Thus, poles 30 and 31 provide the flux flow path for MRE 18. Write coils 13 are disposed about yoke 12. Side gaps 19 composed of silicon dioxide are disposed between one end of yoke 12 near pole 30 and another end of yoke 12 near pole 32. Thus, yoke 12, side gaps 19, poles 30, 31 and 32, and read gap 15 provide a flux flow path for write coils 13.

Hesterman et al. uses head 10 to read from a write to a recording medium with longitudinal magnetic transitions. Moreover, *Hesterman et al.* says nothing about a magnetoresistive element that produces a readback pulse having a substantially Lorentzian pulse shape. In fact, *Hesterman et al.* discloses in Fig. 5 a graph plotting mean flux density in a magnetoresistive element versus position of a single magnetic transition in the medium for two cases: a) without a write gap shunt, and b) with a write gap shunt. In both cases, the mean flux density resembles a step function. Moreover, this is quite similar to the graph of readback pulse voltage versus head position for conventional yoked MR heads in longitudinal recording systems shown in Fig. 4 of the captioned-application.

Hamilton discloses a transducer that transducer that writes to and reads from a perpendicular recording medium. The transducer includes flux-closing pole 30, flux-gated main pole 36, and a gap therebetween. The transducer also includes drive/sense winding 40. Gap 42 resides between main pole 36 and perpendicular recording medium 32, and gap 44 resides between pole 30 and medium 32. Winding 40 is coupled to a flux flow path that includes main pole 36, gap 42, medium 32, gap 44, and pole 30. During a write operation, current is passed through winding 40 to generate flux that provides perpendicular magnetic transitions on medium 32. During a read operation, perpendicular magnetic transitions on medium 32 generate flux that causes electromotive force (emf) in winding 40. Thus, the transducer has no MR read element.

Neither *Hesterman et al.* nor *Hamilton*, alone or in combination, teach, suggest, or even remotely hint that a yoked MR read element produces readback pulses with substantially Lorentzian pulse shapes in response to perpendicular magnetic storage transitions in a storage media, much less a magnetic storage device with circuitry adapted for receiving and detecting such pulses from a yoked MR read element that reads from a perpendicular recording medium.

As the specification makes clear, Applicant does not claim to have invented yoked MR read elements or perpendicular recording media. However, Applicant has discovered that a flux-guided (yoked) MR read element can provide a readback pulse signal with a substantially Lorentzian pulse shape in response to a perpendicular magnetic storage transition. This approach provides numerous advantages, including reducing or eliminating thermal asperities, electrostatic discharge and element material corrosion in the MR head, and avoiding the need for signal processing circuitry, such as a differentiator, that is otherwise used to convert step function waveforms into Lorentzian shaped pulses, which in turn requires additional hardware and increases signal noise.

In sustaining this rejection, the Examiner states "With regard to claims 1-19, 21-37 and 42-60, Hesterman et al in view of Hamilton shows all the features except for the detector being a PR4 detector or a peak detector. Official Notice is taken that is it notoriously old and well known in the art to use a PR4 detector or a peak detector to

detect a Lorentzian-shaped pulse. Applicant even admits that these detectors are old and well known on pages 22 and 23 of the specification. Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to provide the magnetic recording system of Hesterman et al in view of Hamilton with either a PR4 or peak detector. The rationale is as follows: One of ordinary skill in the art at the time of the invention would have been motivated to provide the magnetic recording system of Hesterman et al. in view of Hamilton with either a PR4 or peak detector so that the system can read the Lorentzian-shaped pulse that is produced from the head of Hesterman et al in view of Hamilton."

Applicant disagrees with the Examiner's statement for numerous reasons.

First, the rejection fails to indicate what elements in *Hesterman et al.* are being modified or replaced by elements in *Hamilton*. For instance, if the modification is merely replacing the longitudinal recording medium in *Hesterman et al.* with the perpendicular recording medium in *Hamilton*, then it is unclear whether *Hesterman et al.* would be operative. *Hesterman et al.* fails to teach or suggest that head 10 is designed to operate with a perpendicular recording medium. In fact, in view of magnetic shunt 16 across write gap 17, it is especially unclear how the perpendicular recording flux needed to write to the medium as shown in Fig. 3 of *Hamilton* would be achieved. On the other hand, if the modification includes substituting the head in *Hesterman et al.* with the head in *Hamilton*, then the proposed modification has no yoked MR read element.

Second, the rejection is premised on the notion that one skilled in the art would somehow recognize or understand that the read element in *Hesterman et al.* produces a Lorentzian-shaped pulse in response to a perpendicular magnetic recording transition, and therefore provide a suitable detector. This is completely unsupported. *Hesterman et al.* says nothing about head 10 producing a Lorentzian-shaped pulse or a perpendicular recording medium. In fact, *Hesterman et al.* suggests at Fig. 5 that head 10 produces readback pulse that resembles a step function, as would be expected for a yoked MR head that reads a longitudinal magnetic polarity transition. Likewise, *Hamilton* says nothing

about winding 40 producing a Lorentzian-shaped pulse in response to a perpendicular magnetic recording transition, much less a yoked MR read element doing so.

Third, even if one presumes *arguendo* that bits and pieces of *Hesterman et al.* and *Hamilton* combined with circuitry that receives and detects a Lorentzian-shaped readback pulse (for instance from a non-yoked MR read element in a longitudinal recording system) disclose the elements of independent claims 1, 17 and 30, neither reference even remotely hints at combining these elements to arrive at the claimed invention. Neither reference recognizes that a yoked MR read element can produce a Lorentzian-shaped readback pulse in response to a perpendicular magnetic polarity transition. Therefore, neither reference, alone or in combination, teaches or suggests a magnetic storage system that includes a yoked MR read element, a perpendicular recording medium and circuitry adapted to receive a readback pulse and detect that it has a substantially Lorentzian pulse shape in response to a perpendicular magnetic recording transition.

Therefore, Applicant respectfully submits that the Examiner's hindsight reconstruction using the present invention as a blueprint does not establish obviousness, nor does the Examiner's apparent attempt to employ the long discredited "motivated to try" approach establish obviousness.

Various dependent claims recite additional limitations that distinguish over *Hesterman et al.* and *Hamilton*.

Claim 4 recites "said substantially Lorentzian pulse shape includes a peak near zero head position with respect to said one of said perpendicular magnetic polarity transitions," claim 18 recites "said substantially Lorentzian pulse shape includes a peak near zero head position with respect to and in response to one of said perpendicular magnetic polarity transitions," and claim 43 recites "said readback pulses have peaks near zero head positions with respect to said perpendicular magnetic polarity transitions." Neither *Hesterman et al.* nor *Hamilton* teach or suggest this approach. *Hesterman et al.* discloses applying a mean flux density to the MR element that resembles a step function in which the midpoint (between the positive and negative portions) is near zero head

position with respect to one of the longitudinal magnetic polarity transitions, and *Hamilton* does not disclose a yoked MR read element much less the associated readback pulse. Moreover, the Examiner has not even attempted to address this feature.

Claim 7 recites "said write element includes a non-magnetic spacer for substantially preventing flux flow through said write element during a read operation," claim 28 recites "said write element includes a non-magnetic spacer for substantially preventing flux flow through said write element during a read operation," and claim 51 recites "said yoke includes a non-magnetic spacer in said write flux guide that prevents magnetic flux from circulating through said write flux guide during a read operation." Although *Hesterman et al.* discloses that side gaps 19 are used to reduce or prevent stray magnetic fields from coupling into MRE 18, *Hesterman et al.* does not indicate that side gaps 19 are used to prevent flux flow through a write element during a read operation. Moreover, the Examiner has not even attempted to address this feature.

Claim 20 recites "said circuitry includes means for filtering said readback signal so that said readback signal has a greater resemblance to an ideal Lorentzian pulse shape," and claim 38 recites "said circuitry includes a high pass filter that receives said readback pulses and provides filtered readback pulses, which more closely resemble ideal Lorentzian pulse shapes than said readback pulses, to said detector." Neither *Hesterman et al.* nor *Hamilton* teach or suggest this approach. Although the Examiner asserts that high pass filters are old and well known in the art to remove lower frequencies and one skilled in the art would be motivated to pass pulses received from the magnetoresistive element of *Hesterman et al.* in view *Hamilton* through a high pass filter so that the lower frequencies are removed and the pulses are closer to the ideal Lorentzian shape, as explained above, neither reference teaches or suggests that the head of *Hesterman et al.* produces a Lorentzian-shaped readback pulse in response to a perpendicular magnetic polarity transition.

Claim 34 recites "said detector includes means for detecting Lorentzian pulse shapes." Neither *Hesterman et al.* nor *Hamilton* teach or suggest this approach. Although the Examiner asserts that it would be obvious to use a PR4 or peak detector in *Hesterman et al.* so that the system can read the Lorentzian-shaped pulse that is produced from the head of *Hesterman et al.* in view of *Hamilton*, as explained above, neither reference teaches or suggests that the head of *Hesterman et al.* produces a Lorentzian-shaped readback pulse in response to a perpendicular magnetic polarity transition.

Claim 35 recites "said detector is a class-4 partial response (PR4) detector." Neither *Hesterman et al.* nor *Hamilton* teach or suggest this approach. Although the Examiner asserts that it would be obvious to use a PR4 or peak detector in *Hesterman et al.* so that the system can read the Lorentzian-shaped pulse that is produced from the head of *Hesterman et al.* in view of *Hamilton*, as explained above, neither reference teaches or suggests that the head of *Hesterman et al.* produces a Lorentzian-shaped readback pulse in response to a perpendicular magnetic polarity transition.

Claim 36 recites "said detector is a peak detector." Neither *Hesterman et al.* nor *Hamilton* teach or suggest this approach. Although the Examiner asserts that it would be obvious to use a PR4 or peak detector in *Hesterman et al.* so that the system can read the Lorentzian-shaped pulse that is produced from the head of *Hesterman et al.* in view of *Hamilton*, as explained above, neither reference teaches or suggests that the head of *Hesterman et al.* would produce a Lorentzian-shaped readback pulse in response to a perpendicular magnetic polarity transition.

Claim 39 recites "said magnetic storage device is devoid of a high pass filter between said magnetoresistive read element and said detector." Although the Examiner asserts that the pulses received from the magnetoresistive element of *Hesterman et al.* in view of *Hamilton* will already be substantially Lorentzian-shaped pulses, this premise is improper since, as explained above, neither reference teaches or suggests that the head of *Hesterman et al.* would produce a Lorentzian-shaped readback pulse in response to a perpendicular magnetic polarity transition.

Claim 40 recites "said magnetic storage device is devoid of a differentiator between said magnetoresistive read element and said detector." Although the Examiner asserts that the pulses received from the magnetoresistive element of *Hesterman et al.* in view of *Hamilton* will already be substantially Lorentzian-shaped pulses, this premise is improper since, as explained above, neither reference teaches or suggests that the head of *Hesterman et al.* would produce a Lorentzian-shaped readback pulse in response to a perpendicular magnetic polarity transition.

Claim 41 recites "said magnetic storage device is devoid of signal processing circuitry between said magnetoresistive read element and said detector." Although the Examiner asserts that the pulses received from the magnetoresistive element of *Hesterman et al.* in view of *Hamilton* will already be substantially Lorentzian-shaped pulses, this premise is improper since, as explained above, neither reference teaches or suggests that the head of *Hesterman et al.* would produce a Lorentzian-shaped readback pulse in response to a perpendicular magnetic polarity transition.

Claim 44 recites "said readback pulses are substantially symmetric about zero head positions with respect to said perpendicular magnetic polarity transitions." Neither *Hesterman et al.* nor *Hamilton* teach or suggest this approach. *Hesterman et al.* discloses applying a mean flux density to the MR element that resembles a step function in which the midpoint (between the positive and negative portions) is near zero head position with respect to one of the longitudinal magnetic polarity transitions, and *Hamilton* does not disclose a yoked MR read element much less the associated readback pulse. Moreover, the Examiner has not even attempted to address this feature.

Claim 45 recites "said readback pulses have peaks near and are substantially symmetric about zero head positions with respect to said perpendicular magnetic polarity transitions." Neither *Hesterman et al.* nor *Hamilton* teach or suggest this approach. *Hesterman et al.* discloses applying a mean flux density to the MR element that resembles a step function in which the midpoint (between the positive and negative portions) is near zero head position with respect to one of the longitudinal magnetic polarity transitions,

and *Hamilton* does not disclose a yoked MR read element much less the associated readback pulse. Moreover, the Examiner has not even attempted to address this feature.

Claim 46 recites "said readback pulses have a single voltage polarity with respect to a baseline voltage between said readback pulses." Neither *Hesterman et al.* nor *Hamilton* teach or suggest this approach. *Hesterman et al.* discloses applying a mean flux density to the MR element that resembles a step function in which the midpoint (between the positive and negative portions) is near zero head position with respect to one of the longitudinal magnetic polarity transitions, and *Hamilton* does not disclose a yoked MR read element much less the associated readback pulse. Moreover, the Examiner has not even attempted to address this feature.

Claim 55 recites "said head includes write coils disposed between said first and third pole pieces but not between said first and second pole pieces." Neither *Hesterman et al.* nor *Hamilton* teach or suggest this approach. Moreover, the Examiner has not even attempted to address this feature.

Claim 56 recites "said head includes write coils disposed between said first and second pole pieces." *Hesterman et al.* fails to teach or suggest this approach. Moreover, the Examiner has not even attempted to address this feature.

Claim 57 recites "said yoke includes a write flux guide that defines a write gap and a read flux guide that defines a read gap and is separate from said write flux guide." Neither *Hesterman et al.* nor *Hamilton* teach or suggest this approach. Moreover, the Examiner has not even attempted to address this feature.

Neither *Hesterman et al.* nor *Hamilton*, alone or in combination, teach or suggest key elements of independent claims 1, 17 and 30 as well as numerous dependent claims. Therefore, Applicant respectfully requests that these rejections be overturned.

C. Section 103 Rejection – Claim 55

Claim 55 is rejected under 35 U.S.C. § 103(a) as being unpatentable over *Somers* (U.S. Patent No. 5,097,371) in view of *Hamilton*.

Somers discloses a magnetic head. However *Somers*, like *Hamilton*, fails to teach or suggest a yoked MR read element that produces a Lorentzian-shaped readback pulse in response to a perpendicular magnetic polarity transition, much less circuitry adapted to receive a readback pulse and detect that it has a substantially Lorentzian pulse shape in response to a perpendicular magnetic recording transition. In view of this fundamental deficiency with respect to the base claim 30, Applicant need not address the additional features recited in claim 55.

D. Conclusion

For the reasons given above, Applicant respectfully submits that claims 1-60 are in condition for allowance and respectfully requests that the outstanding rejections be overturned.

I hereby certify that this correspondence is being deposited with the United States Postal Service as First Class Mail in an envelope addressed to: Assistant Commissioner for Patents, Washington, D.C. 20231, on March 2, 2001.

D Sigmond — 3/2/01

David M. Sigmond, Attorney for Applicant — Date of Signature

Respectfully submitted,

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IX. APPENDIX OF CLAIMS INVOLVED IN THE APPEAL

1. A magnetic recording system including a head, a magnetic media with perpendicular magnetic polarity transitions written thereon and circuitry adapted to receive a readback pulse with a substantially Lorentzian pulse shape from said head and to detect said substantially Lorentzian pulse shape, said head for transferring data between the magnetic media and an exterior environment, said head comprising:

a write element for inducing said perpendicular magnetic polarity transitions into a surface of said magnetic media during a write operation;

a yoke having a read gap for sensing said perpendicular magnetic polarity transitions; and

a magnetoresistive read element mounted in a flux flow path of said yoke, wherein said magnetoresistive read element produces a readback pulse having a substantially Lorentzian pulse shape in response to one of said perpendicular magnetic polarity transitions.

2. The magnetic recording system, as claimed in Claim 1, wherein said flux flow path includes a read flux flow path integral with a write flux flow path.

3. The magnetic recording system, as claimed in Claim 1, wherein said read gap of said yoke is disposed at a first distance from said magnetic media and said magnetoresistive read element is disposed at a second distance from said magnetic media, said first distance being smaller than said second distance.

4. The magnetic recording system, as claimed in Claim 1, wherein said substantially Lorentzian pulse shape includes a peak near zero head position with respect to said one of said perpendicular magnetic polarity transitions.

5. The magnetic recording system, as claimed in Claim 1, wherein said head is a planar head.

6. The magnetic recording system, as claimed in Claim 1, wherein said write element comprises a write pole having a leading edge, wherein said leading edge and said read gap are separated by a distance.

7. The magnetic recording system, as claimed in Claim 1, wherein said write element includes a non-magnetic spacer for substantially preventing flux flow through said write element during a read operation.

8. The magnetic recording system, as claimed in Claim 1, wherein

said write element comprises first and second write poles, wherein said first and second write poles have first and second cross-sectional areas, respectively,

said second cross-sectional area being larger than said first cross-sectional area.

9. The magnetic recording system, as claimed in Claim 8, wherein said second cross-sectional area is about 10 to 100 times larger than said first cross-sectional area.

10. The magnetic recording system, as claimed in Claim 1, wherein said yoke includes first, second and third pole pieces in a common plane with said read gap, said common plane being defined by masking during fabrication.

11. The magnetic recording system, as claimed in Claim 6, wherein:

said write pole is integral with said yoke.

12. The magnetic recording system, as claimed in Claim 6, wherein:

said leading edge of said write pole is separated from said read gap by about 2 to about 3 microns.

13. The magnetic recording system, as claimed in Claim 1, wherein said write element comprises a first write pole, a second write pole and a coil element operatively coupled to said first and second write poles for writing to said magnetic media.

14. The magnetic recording system, as claimed in Claim 1, wherein said yoke is integral with said write element.

15. The magnetic recording system, as claimed in Claim 1, wherein said yoke is physically smaller than said write element.

16. The magnetic recording system, as claimed in Claim 1, wherein a length of said read gap ranges from about 0.1 to about 0.2 microns.

17. A magnetic storage device comprising:

a magnetic media having magnetic polarity transitions perpendicularly recorded thereon;

a read element for reading said perpendicular magnetic polarity transitions, said read element including:

a flux guide having a read gap, said read gap used for sensing said perpendicular magnetic polarity transitions and for producing a magnetic flux in said flux guide in response to each of said perpendicular magnetic polarity transitions, and

a magnetoresistive element mounted in said flux guide for producing a readback pulse having a substantially Lorentzian pulse shape in response to said magnetic flux; and

circuitry adapted to receive a readback pulse having a substantially Lorentzian pulse shape from said magnetoresistive element and to detect that said readback pulse has said substantially Lorentzian pulse shape.

18. The magnetic storage device, as claimed in Claim 17, wherein said substantially Lorentzian pulse shape includes a peak near zero head position with respect to and in response to one of said perpendicular magnetic polarity transitions.

19. The magnetic storage device, as claimed in Claim 17, wherein said read gap is disposed at a first distance from said magnetic media and said magnetoresistive element is disposed at a second distance from said magnetic media, said first distance being smaller than said second distance.

20. The magnetic storage device, as claimed in Claim 17, wherein said circuitry includes

means for filtering said readback signal so that said readback signal has a greater resemblance to an ideal Lorentzian pulse shape.

21. The magnetic storage device, as claimed in Claim 17, further comprising:

a write element for writing said perpendicular magnetic polarity transitions on said magnetic media, said write element including:

first and second write poles having first and second ends, respectively, said first and second ends located proximate to a surface of said magnetic media;

a coil element operatively coupled to said first and second write poles for writing to said magnetic media.

22. The magnetic storage device, as claimed in Claim 21, wherein said first and second write poles comprise first and second cross-sectional areas, respectively,

said second cross-sectional area being larger than said first cross-sectional area.

23. The magnetic storage device, as claimed in Claim 22, wherein said second cross-sectional area is about 10 to 100 times larger than said first cross-sectional area.

24. The magnetic storage device, as claimed in Claim 21, wherein said write element is integral with said read element.

25. The magnetic storage device, as claimed in Claim 21, wherein said read element is positioned within said write element.

26. The magnetic storage device, as claimed in Claim 25, wherein said read element is physically smaller than said write element.

27. The magnetic storage device, as claimed in Claim 17, wherein said magnetic media is a rotating disk.

28. The magnetic storage device, as claimed in Claim 21, wherein said write element includes a non-magnetic spacer for substantially preventing flux flow through said write element during a read operation.

29. The magnetic storage device, as claimed in Claim 17, wherein said read element floats above said magnetic media on a cushion of air during a read operation.

30. A magnetic storage device comprising:

a magnetic storage media;

a head including a write element for inducing perpendicular magnetic polarity transitions in said magnetic storage media during a write operation, a yoke, and a magnetoresistive read element mounted in a flux flow path of said yoke and recessed from said magnetic storage media for producing readback pulses with substantially Lorentzian pulse shapes in response to and in one-to-one correspondence with said perpendicular magnetic polarity transitions during a read operation; and

circuitry adapted for receiving readback pulses with substantially Lorentzian pulse shapes from said magnetoresistive read element, wherein said circuitry includes a detector designed to detect Lorentzian pulse shapes.

31. The magnetic storage device, as claimed in Claim 30, wherein said magnetoresistive read element is sufficiently recessed from said magnetic storage media to prevent thermal asperities in said magnetoresistive read element.

32. The magnetic storage device, as claimed in Claim 30, wherein said magnetoresistive read element is sufficiently recessed from said magnetic storage media to prevent electrostatic discharge between said magnetoresistive read element and said magnetic storage media.

33. The magnetic storage device, as claimed in Claim 30, wherein said magnetoresistive read element is sufficiently recessed from said magnetic storage media to prevent chemicals on said magnetic storage media from corroding said magnetoresistive read element.

34. The magnetic storage device, as claimed in Claim 30, wherein said detector includes means for detecting Lorentzian pulse shapes.

35. The magnetic storage device, as claimed in Claim 30, wherein said detector is a class-4 partial response (PR4) detector.

36. The magnetic storage device, as claimed in Claim 30, wherein said detector is a peak detector.

37. The magnetic storage device, as claimed in Claim 30, wherein said detector receives said readback pulses.

38. The magnetic storage device, as claimed in Claim 30, wherein said circuitry includes a high pass filter that receives said readback pulses and provides filtered readback pulses, which more closely resemble ideal Lorentzian pulse shapes than said readback pulses, to said detector.

39. The magnetic storage device, as claimed in Claim 30, wherein said magnetic storage device is devoid of a high pass filter between said magnetoresistive read element and said detector.

40. The magnetic storage device, as claimed in Claim 30, wherein said magnetic storage device is devoid of a differentiator between said magnetoresistive read element and said detector.

41. The magnetic storage device, as claimed in Claim 30, wherein said magnetic storage device is devoid of signal processing circuitry between said magnetoresistive read element and said detector.

42. The magnetic storage device, as claimed in Claim 30, wherein said magnetic storage media includes a magnetic underlayer and a recording media such that the orientation of a magnetic easy axis is perpendicular to a top surface of said magnetic storage media.

43. The magnetic storage device, as claimed in Claim 30, wherein said readback pulses have peaks near zero head positions with respect to said perpendicular magnetic polarity transitions.

44. The magnetic storage device, as claimed in Claim 30, wherein said readback pulses are substantially symmetric about zero head positions with respect to said perpendicular magnetic polarity transitions.

45. The magnetic storage device, as claimed in Claim 30, wherein said readback pulses have peaks near and are substantially symmetric about zero head positions with respect to said perpendicular magnetic polarity transitions.

46. The magnetic storage device, as claimed in Claim 45, wherein said readback pulses have a single voltage polarity with respect to a baseline voltage between said readback pulses.

47. The magnetic storage device, as claimed in Claim 30, wherein said yoke includes a write flux guide that provides a write gap and a read flux guide that provides a read gap, and said read flux guide is integral with and positioned within said write flux guide.

48. The magnetic storage device, as claimed in Claim 47, wherein said yoke includes first, second and third pole pieces, said first and third pole pieces are in said write flux guide and provide write poles that define said write gap, and said first and second pole pieces are in said read flux guide and provide read poles that define said read gap.

49. The magnetic storage device, as claimed in Claim 48, wherein said first, second and third pole pieces are substantially aligned with one another and define a plane that is substantially parallel to a top surface of said magnetic storage media.

50. The magnetic storage device, as claimed in Claim 48, wherein said magnetoresistive read element connects said first and second pole pieces.

51. The magnetic storage device, as claimed in Claim 48, wherein said yoke includes a non-magnetic spacer in said write flux guide that prevents magnetic flux from circulating through said write flux guide during a read operation.